Claims

What is claimed is:

1. A furnace assembly for heating an optical waveguide preform, the furnace assembly comprising:

a furnace including:

a muffle defining a furnace passage, the furnace passage having a length extending from a first end to a second end; and

a heating device operative to heat the furnace passage;

a process gas supply providing a process gas to the furnace passage;

a handle disposed in the furnace passage and adapted to hold the waveguide preform; and

a flow shield positioned between the first and second ends and extending across the furnace passage between the handle and the muffle, the flow shield arranged and configured to restrict flow of the process gas from the first end to the second end of the furnace passage.

2. The furnace assembly of Claim 1 wherein the flow shield defines an isolation chamber between the flow shield and the second end.

3. The furnace assembly of Claim 1 wherein the flow shield has a peripheral edge adjacent the muffle, and the peripheral edge and the muffle define a marginal gap therebetween having a width of between about 2.5 mm and 25 mm.

4. The furnace assembly of Claim 1 wherein the flow shield has a thickness greater than about 6 mm.

5. The furnace assembly of Claim 1 wherein:

the handle extends through a top plate at the second end of the passage; and

the flow shield is disposed between an end of the preform and the top plate.

6. The furnace assembly of Claim 1 wherein the flow shield is coupled to the handle.

7. The furnace assembly of Claim 1 wherein the handle includes a coupling portion to which the preform is attached and a spacer longitudinally separating the flow shield from the coupling portion.

8. The furnace assembly of Claim 7 wherein the spacer separates the flow shield from the preform a distance of at least 50 mm.

9. The furnace assembly of Claim 1 wherein the flow shield is formed of at least one material selected from the group consisting of fused silica, fused quartz, ceramic, silicon carbide, ceramic coated fused silica, and ceramic coated fused quartz, and combinations thereof.

10. The furnace assembly of Claim 1 wherein the handle is formed of at least one material selected from the group consisting of fused silica, fused quartz, ceramic, ceramic coated fused silica, and ceramic coated fused quartz, and combinations thereof.

11. The furnace assembly of Claim 1 wherein the furnace is a waveguide preform holding furnace.

12. The furnace assembly of Claim 1 wherein the furnace is a waveguide preform consolidation furnace.

13. The furnace assembly of Claim 1 further comprising a second flow shield extending across the furnace passage between the handle and the muffle, the first and second flow shields being arranged and configured to restrict flow of the process gas from the first end to the second end, wherein the second flow shield is spaced apart from the first flow shield along the length of the furnace passage.

14. The furnace assembly of Claim 13 including a spacer positioned between the first and second flow shields.

15. The furnace assembly of Claim 1 further comprising a second flow shield extending across the furnace passage between the handle and the muffle, the first and second flow shields being arranged and configured to restrict flow of the process gas from the first end to the second end, wherein the second flow shield is located substantially immediately adjacent the first flow shield.

16. The furnace assembly of Claim 1 wherein:

the furnace includes an end wall;

the flow shield is spaced apart from the end wall and connected thereto by at least one connecting member; and

the handle is free to move relative to the flow shield.

17. The furnace assembly of Claim 1 including a longitudinally extending shield collar extending from the flow shield toward one of the first and second ends, the shield collar including an outer surface facing the muffle, wherein the outer surface and the muffle define a lengthwise restrictive flow passage therebetween.

18. The furnace assembly of Claim 17 wherein the restrictive flow passage has a gap dimension between the outer face and the muffle of between about 2.5 and 25 mm.

19. The furnace assembly of Claim 17 wherein the restrictive passage has a length of between about 25 and 250 mm.

20. The furnace assembly of Claim 17 including a longitudinally extending second shield collar disposed within the first shield collar and including an inner surface facing the handle, wherein the inner surface and the handle define a lengthwise second restrictive passage therebetween.

21. The furnace assembly of Claim 20 wherein the second restrictive passage has a gap width between the inner surface and the handle of between about 1 and 20 mm.

22. The furnace assembly of Claim 20 wherein the second restrictive passage has a length of between about 25 and 250 mm.

23. The furnace assembly of Claim 20 wherein:

the furnace includes an end wall and an exit opening defined in the end wall;

the handle extends through the exit opening; and

the second shield collar extends from the end wall into the furnace passage and surrounds the exit opening.

24. The furnace assembly of Claim 1 wherein:

the furnace includes an end wall and an exit opening defined in the end wall; and

the flow shield comprises a shield collar extending from the end wall into the furnace passage and surrounding the exit opening.

25. The furnace assembly of Claim 24 wherein the shield collar forms a lengthwise restrictive flow passage with at least one of the muffle and the handle.

26. The furnace assembly of Claim 25 wherein the handle extends through the exit opening and the shield collar and the muffle define a first lengthwise restrictive flow passage therebetween and the shield collar and the handle define a second lengthwise restrictive flow passage therebetween.

27. The furnace assembly of Claim 1 wherein:

the furnace includes an end wall and an exit opening defined in the end wall;

the handle extends through the exit opening; and

the furnace assembly further includes a washer slidably mounted about the handle and covering a portion of the exit opening.

28. The furnace assembly of Claim 27 including a plurality of washers slidably mounted about the handle and covering the portion of the exit opening.

29. The furnace assembly of Claim 1 including:

a supply of a second process gas; and

a gas port in fluid communication with the second process gas supply and positioned to direct the second process gas into the furnace passage adjacent a side of the flow shield opposite the preform.

30. The furnace assembly of Claim 29 wherein the first and second process gases are the same.

31. The furnace assembly of Claim 30 wherein the first and second process gas supplies are the same.

32. The furnace assembly of Claim 29 wherein the second process gas is selected from the group consisting of Ar, He, and N_2, and mixtures thereof.

33. The furnace assembly of Claim 29 wherein the gas port is formed in the handle, the handle further comprising a handle passage extending through the handle and fluidly connecting the second process gas supply and the gas port.

34. The furnace assembly of Claim 33 further comprising a second flow shield extending across the furnace passage between the handle and the muffle, the first and second flow shields being arranged and configured to restrict flow of the first process gas from the first end to the second end, wherein:

the second flow shield is spaced apart from the first flow shield along the length of the furnace passage; and

the gas port is positioned between the first and second flow shields.

35. The furnace assembly of Claim 1 including a processing gas port in fluid communication with the process gas supply and positioned to direct the process gas into the furnace passage adjacent a side of the flow shield closest to the preform.

36. The furnace assembly of Claim 1 wherein the handle is free to move relative to the flow shield and the muffle includes a ledge adapted to support the flow shield.

37. The furnace assembly of Claim 35 wherein the process gas is selected from the group consisting of Cl_2, SiF_4, CF_4, SF_6, NF_3, $GeCl_4$, $SiCl_4$, $POCl_3$, BCl_3, BF_3, PCl_3, C_2F_6, and CO, and mixtures thereof.

38. The furnace assembly of Claim 1 wherein the handle is movable relative to the muffle and the flow shield is mounted on the handle for movement therewith.

39. The furnace assembly of Claim 38 including a drive assembly operable to translate the handle and the flow shield relative to the muffle.

40. The furnace assembly of Claim 38 including a drive assembly operable to rotate the handle and the flow shield relative to the muffle.

41. A furnace assembly adapted to heat an optical fiber preform, comprising:

a muffle tube defining a furnace passage, the passage including a length extending from a first end to a second end,

a process gas supply adapted to supply a process gas in the passage directed from the first end to the second end,

a handle adapted to suspend the preform within the passage, and

a flow shield positioned in the passage between the preform and the second end and extending between the handle and the muffle tube, wherein the flow shield is configured to enable restriction of flow of the process gas.

42. A furnace assembly adapted to heat an optical fiber preform, said assembly comprising:

a muffle tube including a passage;

a top plate mounted on an end of the tube;

a gas supply for supplying process gas to the passage;

a handle traversing the top plate and adapted to suspend the preform in the passage; and

a flow shield positioned in the passage between the preform and the top plate, wherein the flow shield is configured to enable restriction of the gas.

43. A flow restrictor assembly for an optical fiber furnace adapted to heat an optical fiber preform, the assembly comprising:

a top plate having a passage of a first dimension formed therethrough;

at least one solid flow restrictor having a hole of a second dimension formed therethrough; and

a handle inserted through the passage and the hole, the handle adapted to suspend the preform wherein the first dimension is larger than the second dimension.

44. A method of manufacturing an optical fiber preform, comprising the steps of:

flowing a process gas in a furnace passage of a muffle tube from a first end to a second end, the furnace passage having the optical fiber preform mounted therein, and

restricting flow of the process gas using a flow shield positioned in the passage between the preform and the second end and extending between a handle and the muffle tube.

45. The method of Claim 44 wherein the process gas is flowed through the muffle tube at a rate of no more than 30 slpm.

46. The method of Claim 44 wherein the process gas is flowed through the muffle tube at a rate of no more than 10 slpm.